

Amendments to the Claims

This listing of claims will replace all prior versions and listings of claims in the application:

Listing of Claims:

1. (Cancelled).

2. (Cancelled).

3. (Currently amended) ~~A solenoid in accordance with Claim 1 A~~
solenoid for providing linear actuation, comprising:

a) first and second polepieces having axial bores coaxially disposed along a common axis;

b) an electrical conductor wound about said polepieces in a plurality of turns;

c) an armature movably disposed in said axial bores, wherein said armature is frusto-conical, said frusto-conical section being adjacent to a substantial portion of said first and second polepieces;

d) a bearing axially retained in one of said first and second polepieces; and

e) a shaft attached coaxially to said armature and extending through a supportive bore in said bearing wherein said bearing radially supports said shaft, said shaft being axially displaceable by electromagnetic displacement of said armature to provide said actuation, wherein said armature is entirely separated from said axial bores of said polepieces by a generally cylindrical air gap, and wherein the armature is prevented from contacting the polepieces.

4. (Currently amended) A solenoid in accordance with Claim [[1]] 3 wherein said solenoid is included in an actuator attachable to a device for providing linear actuation to said device.

5. (Currently amended) A solenoid in accordance with Claim [[1]] 3 wherein the respective diameters of said bearing bore and said shaft are as nearly identical as is possible without engendering drag on said shaft.

6. (Currently amended) A valve assembly for exhaust gas recirculation between the exhaust manifold and the intake manifold of an internal combustion engine, said assembly including an exhaust gas recirculation valve and further including a solenoid actuator attached to said valve, said solenoid actuator having first and second polepieces having axial bores coaxially disposed along a common

axis, an electrical conductor wound about said polepieces in a plurality of turns, [[an]] a frusto-conical armature movably disposed in said axial bores, said frusto-conical section being adjacent to a substantial portion of said first and second polepieces, a bearing axially retained in one of said first and second polepieces, and a shaft attached coaxially to said armature and extending through a supportive bore in said bearing wherein said bearing radially supports said shaft, said shaft being axially displaceable by electromagnetic displacement of said armature to provide actuation of said valve, and wherein said armature is entirely separated from said axial bores of said polepieces by a generally cylindrical air gap, and wherein the armature is prevented from contacting the polepieces.

7. (Currently amended) An internal combustion engine, comprising:

- a) an intake manifold;
- b) an exhaust manifold; and
- c) a valve assembly for exhaust gas recirculation between said exhaust manifold and said intake manifold, said assembly including an exhaust gas recirculation valve and further including a solenoid actuator attached to said valve and having first and second polepieces having axial bores coaxially disposed along a common axis, an electrical conductor wound about said polepieces in a plurality of turns, [[an]] a frusto-conical armature movably disposed in said axial bores, said frusto-conical section being

adjacent to a substantial portion of said first and second polepieces, a bearing axially retained in one of said first and second polepieces, and a shaft attached coaxially to said armature and extending through a supportive bore in said bearing wherein said bearing radially supports said shaft, said shaft being axially displaceable by electromagnetic displacement of said armature to provide actuation of said valve to admit exhaust gas from said exhaust manifold into said intake manifold, and wherein said armature is entirely separated from said axial bore of said polepieces by a generally cylindrical air gap, and wherein the armature is prevented from contacting the polepieces.

8. (Cancelled).

9. (Cancelled).

10. (Currently amended) ~~A solenoid in accordance with Claim 8 A~~
solenoid for providing linear actuation, comprising:

- a) a housing;
- b) first and second polepieces, within said housing, having axial bores coaxially disposed along a common axis;
- c) an electrical conductor wound about said polepieces in a plurality of turns;

d) an armature movably disposed in said axial bores, wherein said armature is frusto-conical, said frusto-conical section being adjacent to a substantial portion of said first and second polepieces;

e) a bearing axially retained in one of said first and second polepieces; and

f) a shaft attached coaxially to said armature and extending through a supportive bore in said bearing wherein said bearing radially supports said shaft, said shaft being axially displaceable by electromagnetic displacement of said armature to provide said actuation, wherein said armature is entirely separated from said axial bore of said polepieces by a generally cylindrical air gap, and wherein the armature is prevented from contacting the polepieces.

11. (Currently amended) A solenoid in accordance with Claim [[8]] 10 wherein said solenoid is included in an actuator attachable to a device for providing linear actuation to said device.

12. (Currently amended) A solenoid in accordance with Claim [[8]] 10 wherein the respective diameters of said bearing bore and said shaft are as nearly identical as is possible without engendering drag on said shaft.

13. (Currently amended) A ~~solenoid in accordance with Claim 1 A~~ solenoid for providing linear actuation, comprising:
- a) first and second polepieces having axial bores coaxially disposed along a common axis;
 - b) an electrical conductor wound about said polepieces in a plurality of turns;
 - c) an armature movably disposed in said axial bores;
 - d) a bearing axially retained in one of said first and second polepieces; and
 - e) a shaft attached coaxially to said armature and extending through a supportive bore in said bearing wherein said bearing radially supports said shaft, said shaft being axially displaceable by electromagnetic displacement of said armature to provide said actuation, wherein said armature is entirely separated from said axial bores of said polepieces by a generally cylindrical air gap, and wherein said bearing has an axial length that is at least 1.5 times larger than the diameter of said shaft.

14. (Previously presented) A solenoid in accordance with Claim 6 wherein said bearing has an axial length that is at least 1.5 times larger than the diameter of said shaft.

PATENT

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15. (Previously presented) A solenoid in accordance with Claim 7
wherein said bearing has an axial length that is at least 1.5 times larger than the
diameter of said shaft.

16. (Currently amended) A solenoid in accordance with Claim [[8]] 10
wherein said bearing has an axial length that is at least 1.5 times larger than the
diameter of said shaft.